Moisture Content Determination for Several Eucalyptus Wood by NIRS: Monospecific PLS Models vs Multispecies Model

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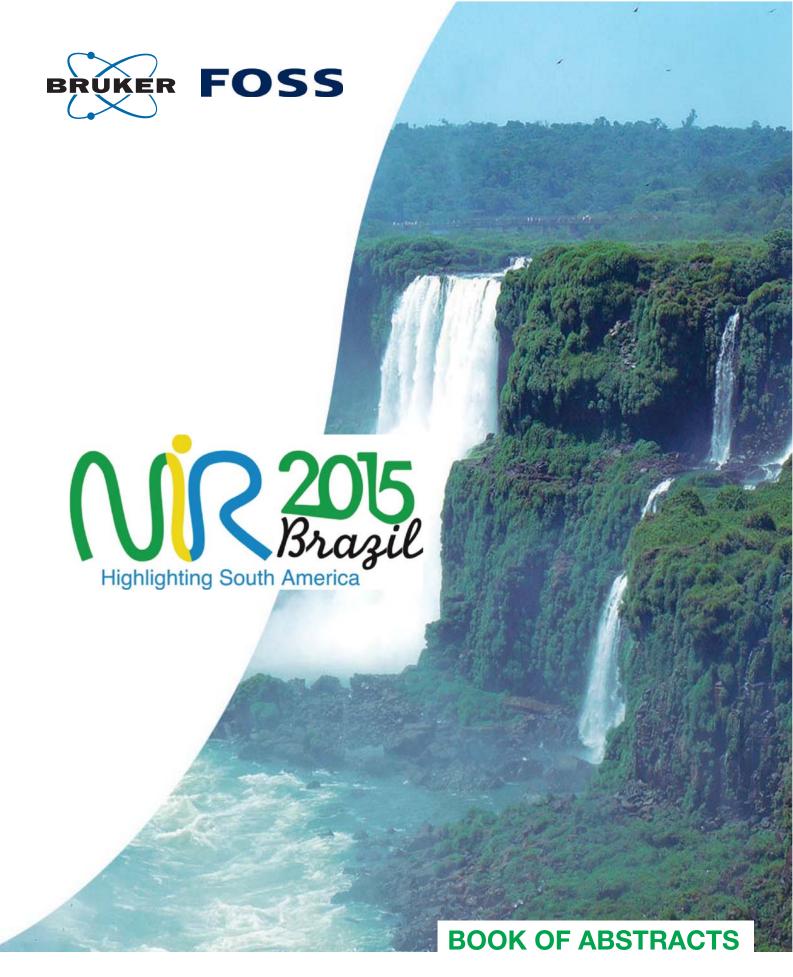
Introduction: MC (moisture content) of wood is crucial for the transformation sector. MC vary widely because of its highly anisotropic characteristics which has a direct influence on physical and mechanical properties, both as a raw material and when utilized in various forest products as lumber, paper, charcoal and composite panels. The MC determination can be estimated by NIRS associated to non-destructive sampling. Hence, with this objective, we built global NIRS models for MC by using Eucalyptus multispecies datasets from Brazil. We tested MC variability and NIRS to build robust MC model.

Experience: We collected wood disks on 8 to 25 year-old Corymbia maculata, Eeucalyptus grandis, E. resinifera, and E. cloeziana trees (10 per species). Diametric bands cut from the disks were divided in 15 x 20 x 20 mm samples. They were theoretically stabilized at 8, 10, 12, 14, 16, and 18% of MC. At each MC, we measured spectra on the same sanded longitudinal face and their weight. Spectra were measured under diffuse reflection using integration sphere of a Bruker MPA spectrometer, each spectrum constituted of 32 scans. Spectral analysis was performed within the 9,000–3,500 cm⁻¹ range at 8 cm⁻¹ resolution. The mass of oven-dry wood per unit of volume of green wood is expressed in grams per cubic centimeter. Real MC was calculated by taking into account the dry weight data. We used Unscrambler software 10.3 (Camo, Norway) for PLS regression for MC, for all species or separately. Cross-validations with 5 groups of random samples were performed to build the models for each species and for the global model. Then, we used test set validations randomly selected along the MC variability and compare model performances. Finally, we compared on validation test set for the 4 species, the predicted values both by specific models and global model.

Results and Discussions: The real MC varied from 9 to 22%, showing bias with the expected MC, according to the species. Global models for MC including the 4 species, showed RPD = 3.3 with SEP value of 0.7%. Depending the species, the specific models showed a RPD from 3.5 to 4.3 with lower SEP from 0.4 to 0.5%. As expected, models developed with spectra of theoretical MC were less efficient than the model developed with spectra selected at corrected MC. The local models (or specific models) were more reliable in terms of prediction error than the global model in term of error of prediction because the local method appears to cope with the non-linearity and non-homogeneity associated with a large multispecies dataset. This is consistent with approaches developed with local models. The comparison between predicted values by local and global models showed r² from 0.89 to 0.98 with standard error 0.3 to 0.6%.

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